

# Cold Climate Region: Case Study #1

## City of Boulder, SmartRegs Ordinance

### Single Family Detached, 1960's Vintage

#### Boulder, CO

Program	SmartRegs Ordinance
Location:	Boulder, Colorado
Building Type:	Single Family Detached
Building Size:	955 ft <sup>2</sup>
Foundation:	Unconditioned Crawlpace
Configuration:	3 bedrooms, 1 bath
SWA Contact:	Lois Arena

This single family detached rental property is located in Boulder, CO, in an area well known for its small, ranch style homes very often used as rental property. Typical of homes built in the 1950's and 1960's in Boulder, it is a 3 bedroom, 1 bathroom single-story house just under 1,000 ft<sup>2</sup> built over a crawlspace foundation.

The property owner was one of several people to sign up early for the SmartRegs audit to ensure that his rental property complies with the City of Boulder's new requirements that all rental properties meet a certain energy efficiency level by 2019.

As is evident from the owner's answers to several interview questions (see Property Owner's Story), he is very committed to energy conservation and wanted to know as early as possible if his properties complied with the new regulations. If not, this would give him time to plan for the needed upgrades.

Because of the owner's commitment to energy conservation, he had already made several energy improvements to the property before the new regulations were put in place. The attic had been air sealed and insulated to approximately R-38. The exterior walls (2x4) were dense-packed with cellulose insulation, and all windows were upgraded to double-pane, low-e, vinyl units with U-values of 0.30. The crawlspace ceiling had been insulated and air sealed from the house and the existing ductwork located in the crawl had been insulated.

Air leakage and pressure testing confirmed that both the attic and the crawlspace were well isolated from the main living area. Based on the blower door result of 986 cfm@50 pascals, the estimated infiltration rate of this home is approximately 0.44 air changes per hour under natural conditions (ACHn) or 8 ACH@50 pascals.



***This rental property passed Boulder's SmartRegs requirements upon initial inspection.***

#### Energy Efficient Features

Attic:	Blown-in cellulose insulation—R38
Walls:	Dense-packed cellulose—R-13
Windows:	Low-e, double-pane, vinyl—U-0.30
Foundation:	Fiberglass batts—R-11 in crawlspace ceiling
Heating:	Forced air, natural gas, conditioned space—80 AFUE
Cooling:	None
Ductwork:	Insulated w/ R-4 fiberglass batts, unconditioned space
Hot Water:	Atmospheric, natural gas, conditioned space—0.59 EF
Air Leakage:	8 ACH@50 pascals, 0.44 ACHn

#### Additional SmartRegs Features

Water-saver faucets and showerheads

#### SmartRegs Checklist Score\*: 100 points

(The final score must be ≥ 100)

#### HERS Index: 100

\*100 points on the SmartRegs checklist was intended to approximately equate to a HERS index of 120.

## Boulder, CO

The owner of this property opted to use the prescriptive method of compliance and have the auditor fill out a checklist rather than perform energy modeling to determine if the property was in compliance. Based on the auditors assessment, this home scored 100 points on the SmartRegs checklist and is, therefore, in compliance with the program (confirmed by SWA during a follow up audit) The owner is not required to make any further energy related improvements at this time.

When creating the prescriptive checklist, the authors set out to create a threshold that would apply to all homes. After extensive analysis, it was determined that 100 points on the checklist should approximately equate to a HERS index of 120 points, more or less. SWA checked this assumption by modeling the home using REM/Rate, a simulation program used for analyzing energy use in residential buildings. The HERS index for this property was determined to be 100, far lower than the required score.

There could be several reasons for this. First, the SmartRegs' prescriptive checklist does not give any credit for insulation in a crawlspace ceiling (R-11 in the ceiling of this crawlspace) if the mechanical equipment and/or any of the ductwork are located in that space.

The City's reasoning behind this is that one of the goals of the SmartRegs program is to promote the most cost-effective, energy efficient improvements while improving living conditions—comfort, safety, indoor air quality etc.—for the renters. The city of Boulder feels that converting unconditioned crawlspaces to conditioned, air sealed, warm, dry spaces is one of the measures that will help them achieve these goals. When modeling this home, the insulation in the crawlspace was included, and therefore, could result in a lower HERS index than would correspond to the achieved 100 points on the SmartRegs checklist.

## Facts about SmartRegs

2 Compliance Paths: Prescriptive or Performance

- Prescriptive: 100 points on Checklist
- Performance: HERS Index  $\leq$  120



***This home receives no credit for the crawlspace ceiling insulation because the majority of the ductwork is located here.***



***Main supply plenum from down flow furnace with supply branch takeoffs. 99% of the supplies are located in this crawl.***

Also, the affects of conditions like solar exposure, window to wall ratio and roof color are not evaluated on the checklist but can drastically affect a HERS Index, especially in a sunny climate like Colorado's.

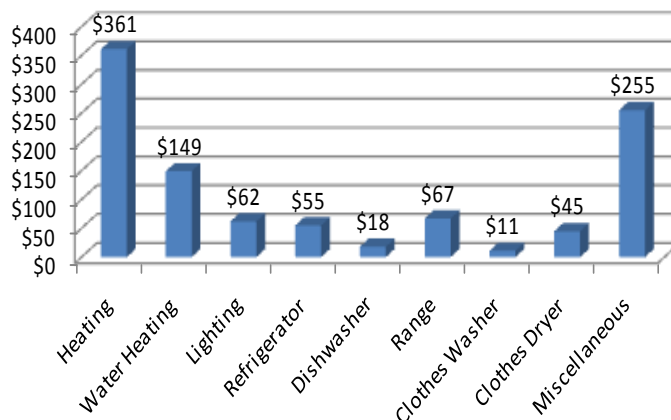
## Boulder, CO

SmartRegs requirements were adopted to meet the city's sustainability objectives including environmental health, economic vitality and social equity. According to current statics, rental properties comprise approximately 50 percent of Boulder's housing stock<sup>1</sup>. Therefore, by requiring property owners to upgrade rental properties, the SmartRegs program aids in advancing Boulder's community sustainability objectives, and will hopefully result in lower energy bills for tenants.

Predicted annual utility bills for this property are displayed in the graph to the right. REM/Rate predicts an overall annual utility bill of \$1022: about  $\frac{1}{3}$  (\$361) is attributed to heating.

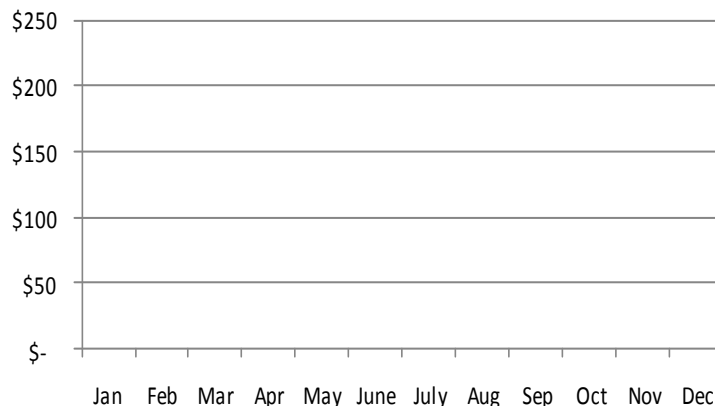
To better analyze programs like SmartRegs, comparisons to actual utility bills are critical. Unfortunately, obtaining utility bills from major providers has been and remains incredibly difficult, even with signed consent forms from homeowners or renters. While this is not necessarily a barrier to program implementation, it is a huge barrier to improving these programs and ensuring that the upgrades being recommended are effective from an energy reduction and a cost-effectiveness standpoint. Removing this barrier is essential in meeting long term program goals.

### Predicted Annual Energy Costs



**Predicted Monthly Utility Bills from REM/Rate.**

### Actual Utility Bills: 2010-2011



**Actual Utility Bills Could Not Be Obtained.**

<sup>1</sup>2011 SmartRegs Handbook, City of Boulder



### Boulder, CO

The property owner was interviewed to determine his feelings and concerns about Boulder's new SmartRegs ordinance. A summary of his opinions and suggestions for improvements are below.

**Q: Why did you decide to participate now and not wait till later in the process?**

A: The owner has a long-term interest in energy conservation; "I'm way out in front of what's commonplace for rentals." He also felt that if upgrades were needed, he could determine the most economical course of action and allow for future planning for appliance replacement. This owner owns two rentals and both passed (SmartRegs), so there was no benefit for him in that way (no action required), though if this house had more sun, he would also have added PV.

**Q: How long has the owner owned this property?**

A: Thirty-six years, since 1975.

**Q: Are you educating the occupants about what and why renovations are taking place and how it will benefit them?**

A: It's easy with this tenant because he works for Boulder Housing Authority. The tenant posted a copy of the SmartRegs certificate on the refrigerator for all to see!

**Q: What's the vacancy rate for your property?**

A: Zero

**Q: What are your thoughts or comments for others?**

A: This owner felt that the focus of this program should be on reducing use of air conditioning because of peak summer demand pushing the city to more power plants. He suggested that solar arrays should be oriented to offset late afternoon summer to aid in reducing summer peak demands. He is also a big proponent of ground source heat pumps and feels they should be used more widely.

NOTE: SWA feels there are arguments for and against ground source heat pumps, and each application should be analyzed individually to determine if the technology is a good fit.

**Q. What is your normal maintenance routine – i.e., every few months, once a year, on occupant turn over?**

A: Maintenance and general improvements are done during tenant transition, and during crises! The owner relies on the tenant to advise when things are broken.

*Steven Winter Associates, Inc. is the lead for the Department of Energy's Building America team called the Consortium for Advanced Residential Buildings (CARB).*

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